Instantaneous Field of View and Spatial Sampling of the Airborne Visible/Infrared imaging Spectrometer (AVIRIS)

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Abstract

The Airborne Visible/infrared Imaging Spectrometer (AVIRIS) measures the upwelling radiance in 224 spectral bands. These data are acquired as images of approximately 11 by up to 100 km in extent at nominally 20 by 20 meter spatial resolution. In this paper we describe the uderlying spatial sampling and spatial response characteristic of AVIRIS.

1,0 AVIRIS Spatial Resolution and Sampling Interval

The spatial field stop of the AVIRIS optical system is defined by one of four 200 pm circular fibers for each of spectrometers (Chrisp et al., 1987). The numerical aperture of the fibers tapers off smoothly at the edges. In otherwords, it is not a sharp pill-box function, but a circularly symmetric Gaussian-like function. By the time you add aberrations and scanner smear, a circularly symmetric Gaussian is an excellent approximation. This is shown in Figure 1 for data measured in the laboratory from a narrow beam (O. 1 milliradians) of collomated light scanned across a portion of the AVIRIS field of view (FOV). The slightly jagged nature of the data represents line-to-line scan jitter.

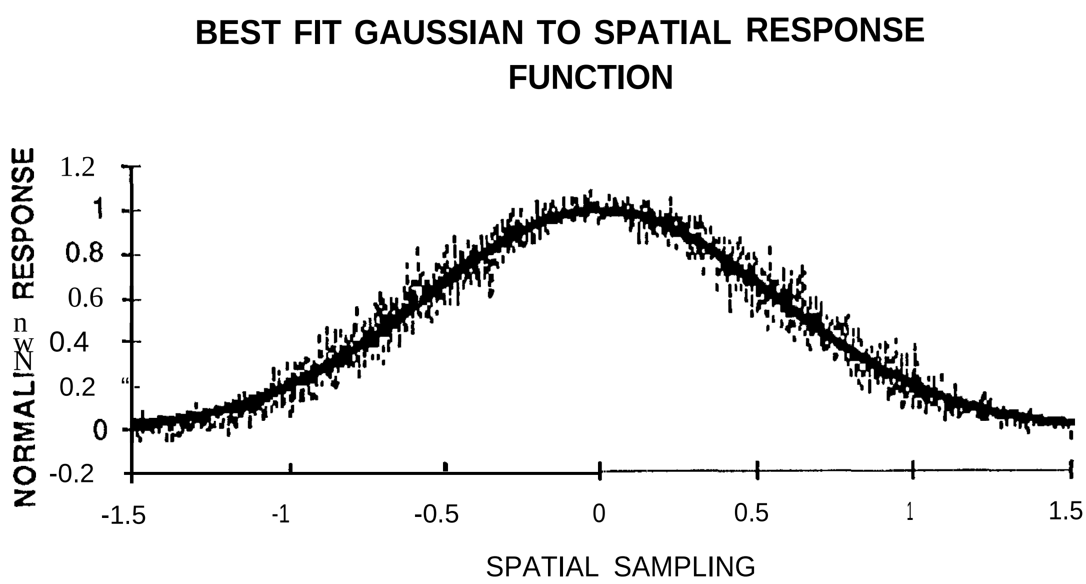

Figure 1. AVIRIS spatial response function.

The AVIRIS spatial response function or instantaneous field of view (IFOV), including scan smear is a Gaussian function with a FWHM of 1.313 spatial samples and a line,-to-line RMS jitter of 0.077 spatial samples. Adjacent pixel samples within a given line are separated by 0.8S milliradians(Miller, 1987). Using this factor to convert to milliradians, the IFOV is 1.12 milliradians and the line-to-line. jitter is 0.066 mill Iranians. Cross-track, these, figure are independent of altitude. Ground spot sizes are, of course, the product of IFOV (in radians) and lilt aircraft platform altitude (AGL). AVIRIS operates from a NASA ER-2 at nominally 20 + -1 km altitude above sea level. A diagram of these relationships is shown in Figure 2., where s(n) refers to the nth cross-track sample.

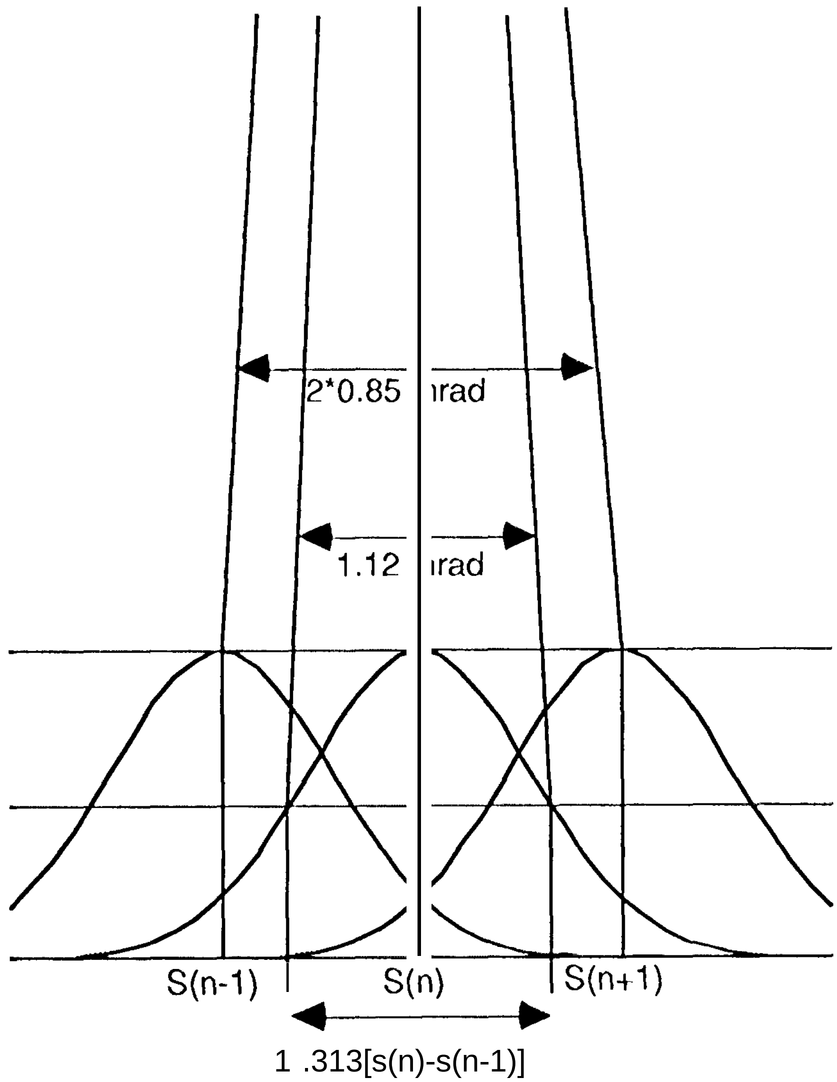

Figure 2. Goss-track sampling

The detector read-out delay will cause a (n- 1)/66 sample shi ft, where n is the read-out position of spectral channel with respect to each of the four spectrometers. Table 1. can be used to determine the appropriate value for the index n for a given spectral channel. 'Ibis mad-out delay is compensated in the radiometricall y calibrated data distributed to investigators (Green et al 1991).

Table 1. The index n for various spectral channels

Spectrometer	Channel	n
A	001	1
	932	32
B	033	1
	096	64
C	097	
	160	[illegible]
D	161	1
	224	64

The down-track sampling distance is duc entirely to the motion of the aircraft from line to line. 'l'his is determined by the product of the aircraft velocity and the line repeal period of 1/12 of a second. For the ER-2, this distance is nominally 17 meters. Figure 3 shows the sampling where L(k) refers to the kth down-track line. in the down-track case, the GIFOV spot size can become less than the sampling interval for mountains above 4,8 km AS I. when the aircraft is at 20 km ASl..

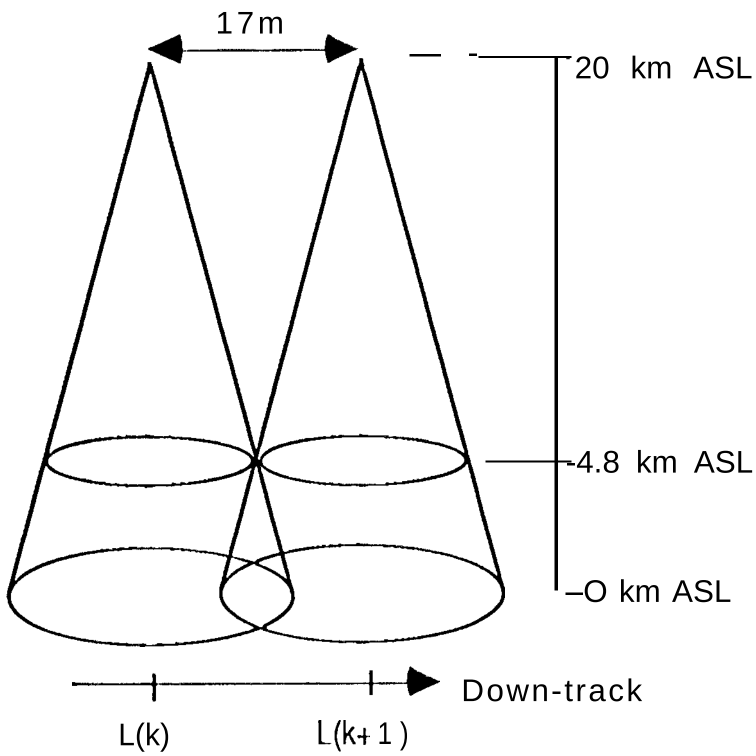

Figure 3. Down-track sampling.

2.0 Summary

The spatial sampling and spatial response function of the AVIRIS system in the cross and down track directions have been dc.scribed. These characteristics should be taken into account when quantitatively measuring expressed spectral abundance of descrete objects of less than 20 by 20 m size.

3.0 Acknowledgements

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4.0 References

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